

# Integrated clinical training for space flight using a high-fidelity patient simulator in a simulated microgravity environment

**Victor Hurst IV, Ph.D.**

Harold K. Doerr, M.D.

James D. Polk, M.D.

Josef Schmid, M.D.

Scott Parazynksi, M.D.

Scott Kelly

Questions about the study? Please contact...

Victor Hurst: [vhurst@wylehou.com](mailto:vhurst@wylehou.com) ; (281) 212-1460

# Overview

- Background
- Methods
- Review of Techniques
- Findings
- Conclusion

# Background

- For decades, telemedicine techniques have been used in terrestrial environments by many cohorts with varied clinical experience.
- These cohorts include 911 operators, military medics and board certified physicians.
- The success of these techniques has been recently expanded to include microgravity environments aboard the International Space Station (ISS).

# Background

The successful acquisition of high-quality ultrasound images from the ISS using remote guidance techniques\* has demonstrated the effectiveness of telemedicine protocols during space flight.



ISS005E15408

\* Advanced Diagnostic Ultrasound in Microgravity (ADUM); Dulchavksy *et al.*)

# Background

- To expand the use of remote guidance for managing medical events during space flight, NASA Space Medicine is developing formal remote guidance training for the Flight Surgeon (FS) cohort.
- These training exercises, which will eventually include crew, are designed for a microgravity environment but are usually performed in a terrestrial (1g) environment

# Background

The NASA-JSC FS Office along with the Medical Operation Support Team (MOST) identified a need to examine how an astronaut crew medical officer (CMO) will execute medical tasks in a microgravity environment while being remotely guided by a flight surgeon (FS).



# Background

As a result, the MOST was requested by the NASA FS Office to develop a preliminary exercise to examine team resource management between a CMO and flight surgeon as they handle a medical event in a microgravity environment.

# Methods

- The MOST developed space-relevant patient models/scenarios to be presented on a high-fidelity patient simulator in a simulated microgravity environment.
- These scenarios and the corresponding strategies to mitigate these medical conditions underwent a preliminary evaluation by FS and astronauts in the simulated microgravity environment provided aboard DC-9 aircraft.
- Each FS was tasked to remotely guide the astronaut through two medical scenarios. Medical equipment specific to the ISS was used for each scenario.
- All participants were debriefed to collect feedback.



# Methods

- Each CRG session consisted of a physician acting as the FS and another participant acting as the CMO.
- On each flight day, the proctors of the study provided the FS-CMO teams with a background of the medical scenario they were going to manage during the flight.
- Once in position, the FS and CMO conducted the scenario using ISS HMS equipment when primarily exposed to the simulated microgravity environment provided by the aircraft.
- Each CRG session lasted 10 parabolas or approximately 5 minutes of simulated microgravity.

# Methods

- The two medical conditions presented on the ECS to the FS-CMO teams in random order were:
  - tension pneumothorax
  - negative pressure pulmonary edema.
- To minimize variability between RG sessions, the ECS was programmed to present the symptoms of each condition with the same timeline.
- All data were recorded using audio/video data collection systems provided by either Wyle Laboratories (Reduced Gravity Media Rack) or the NASA-JSC Photography office. All video data were converted to DVD format for retrospective analysis by the MOST investigators.

# Experimental Configuration



# Video of Remote Guidance



# Results

- Feedback from flight video and post-flight debriefs indicated that performance of medical tasks by the CMO/CMO analogues while being remotely guided by the FS was sufficient for mitigating the medical scenarios presented.

# Next Steps with this Experimental Training

- The MOST is working with the Field Medical Training Lead (FMT) from the NASA Astronaut Office to determine how, if it all, this training may compliment the FMT given to astronauts before ISS Missions.
- Data collected from flights that will be conducted in July 2007 will be analyzed and presented to both the NASA Flight Surgeon and Astronaut Offices for review.
- Pursuant to the results from the flights, the MOST will work with representatives from both the NASA Flight Surgeon and NASA Astronaut Offices to identify what additional training will be needed, if any, for space shuttle and ISS crew medical officers (CMO) and physician astronauts.